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Two new species of myxosporidians, *Myxosoma channai* n.sp. and *Myxobolus tripathii* n.sp. from fresh water fishes of Andhra Pradesh

C KALAVATI, B V SANDEEP and C C NARASIMHAMURTI
Department of Zoology, Andhra University, Waltair 530 003, India

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Abstract. Two new species of myxosporidians, *Myxosoma channai* n.sp. infecting the fins, body muscles, liver and kidney of *Channa punctata* Bl. and *Myxobolus tripathii* n.sp. infecting the gut and the liver of *Clarius* sp. are described. A checklist of all the species of myxosporidians reported from fishes of India is also given.

Keywords. *Myxosoma channai* ; *Myxobolus tripathii* n.sp. ; *Channa punctata* ; *Clarius* sp. ; new species.

1. Introduction

Southwell and Prashad (1918) reported the first myxosporidian from Indian fishes. Later Ray (1933), Chakravarty (1939, 1943), Ganapati (1941), Setna (1942), Chakravarty and Basu (1948), Tripathi (1952), Qadri (1962a–d, 1965, 1967, 1969 and 1970), Bhatt and Siddiqui (1964), Qadri and Lalitakumari (1965), Lalitakumari (1969), Chaudhuri and Chakravarty (1970), Choudhury and Nandi (1973), Narasimhamurti (1970), Narasimhamurti and Kalavati (1975, 1979a–c), Narasimhamurti *et al* (1980) described a number of myxosporidians belonging to different genera from fishes of India. Tripathi (1952) gave a review of the work done till 1952 and gave a checklist of all the myxosporidians reported till that time.

So far about 80 species of myxosporidia (table 2) have been described from Indian fishes. A checklist of all the species of myxosporidians described so far from India is included in the present paper because there is no such compilation after 1952 (Tripathi 1952).

While examining the fresh water fishes of Visakhapatnam District we came across 2 myxosporidians, one belonging to the genus *Myxosoma* infecting the fins, body muscles, liver and kidney of *Channa punctata* Bl. and the other belonging to the genus *Myxobolus* infecting the muscles of the gut and liver of *Clarius* sp. Both of them are considered new to science and are described in this paper.

2. Materials and methods

Channa punctata Bl. were collected from 3 different places in Visakhapatnam District ; from a fresh water tank used mostly for drinking purposes located at the foot of hill in Srungavarapukota, about 30 miles north of Visakhapatnam ; from an abandoned tank which has highly polluted water and plenty of green algae in Elamanchili, about 38 miles south of Visakhapatnam and a stream near the Dairy farm in Visakhapatnam. *Clarius* sp. were collected from a tank near the Visakhapatnam Port.

Different parts of the body of the fish were examined for myxosporidian parasites and when infection was detected as evident by the presence of cysts, smears were prepared, air-dried and fixed in methyl alcohol, hydrolysed in 1N HCl at 60° C for 10 min and stained with Giemsa. Smears were also wet-fixed in Schaudinn's or Carnoy's fluid and stained with Heidenhain's iron haematoxylin or according to Feulgen's technique. Fresh spores were treated with india ink and lugol's iodine to detect the presence of any mucous envelope and iodinophilous vacuole. The measurements and drawings of the spores were made in the fresh condition.

3. Observations

Myxosoma channai n. sp. Host: *Channa punctata* Bl.
Site of infection: Fins, body muscles, kidney and liver.
Type slides: Author's Collection at Department of Zoology, Andhra University, Waltair (Andhra Pradesh).

68 out of 132 (51·5%) of *Channa punctata* Bl. collected from 3 different localities in Visakhapatnam District during February–April 1979 were, found infected with a new species of *myxosoma*. The size of the fish, the site and percentage of infection differed in fish collected in the different places (table 1).

32 fish brought from Srungavarapukota were maintained in aquaria tanks and fed with commercially available fish food. Infected fish from this area showed infection predominantly in the kidney and to a lesser extent in the liver. The

Table 1. Incidence of *M. Channai* in fishes collected from different localities in Visakhapatnam District.

Place	Site of infection	Size	Number examined	Number infected
Fresh water tank Srungavarapukota	Kidney and Liver	6″–7″	32	24
Fresh water tank Elamanchili	Body muscles	4″–6″	36	4
Dairy farm stream Visakhapatnam	Fins	$2\frac{1}{2}$″–$3\frac{1}{2}$″	32	20

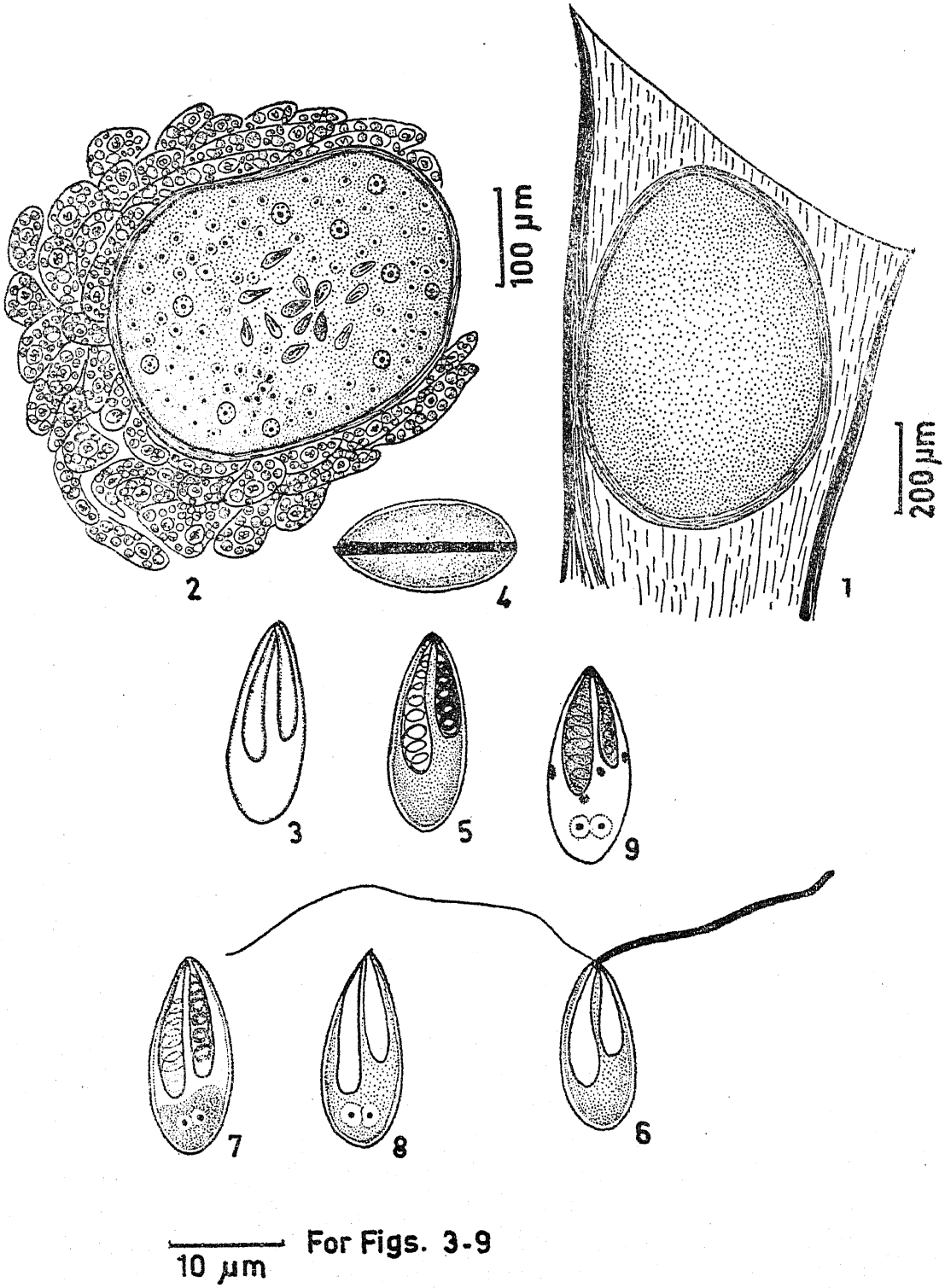
infection was heavy and each fish yielded about 10 cysts. Five out of the 7 fish which were sacrificed immediately after being brought to the laboratory showed heavy infection. More cysts were either superficially attached or deeply embedded in the kidneys and a lesser number in the liver. Unfortunately all the cysts were immature and did not show any spores. The rest of the 25 fish were maintained in the laboratory. Five of them died in 7 days and they showed infection both in the kidneys and the liver, heavier in the former than in the latter. Sections of the kidney showed cysts with few spores in the centre and developmental stages along the periphery (figure 2). The remaining 20 fish were maintained in the laboratory for another 2 weeks. The fish appeared active and there were no casualities during that period. All the fish were sacrificed at the end of 2 weeks and examined for infection and 14 of them showed heavy infection in the kidneys.

Four of the 36 fish (11%) brought from Elamanchili showed the infection limited to the body muscles. The size of the cysts varied from 0·2–0·5 mm in diameter. The infection was lighter and yielded 3 and 4 cysts in each of the 2 infected fish.

Twenty out of the 32 fish collected from the stream near the dairy farm area, Visakhapatnam showed infection limited to the fins. The infection was heavy and as many as 10 cysts were recovered from each fish. The infection was prevalent in the smaller fish and was absent in the larger fish. Cysts measuring 800–1020 μm in diameter were either spherical or oval and were surrounded by a thin membrane (figure 1).

Sections of early cysts showed two types of nuclei, the larger nuclei which were fewer in number had a conspicuous large endosome and a distinct nuclear membrane and were probably the generative nuclei while the smaller ones which were more numerous had a small dot-like endosome and an indistinct nuclear membrane which were probably the somatic nuclei (figure 2).

Spores: The spores were pale brown in colour, elongately oval and had a bluntly pointed anterior end and a rounded posterior end. They measured 14·5–18 × 6–6·5 μm. The two spore valves meet along a conspicuously thick median sutural ridge (figure 4). Two polar capsules which are elongate and pear-shaped were of dissimilar size and were situated one on either side of the median line. The larger polar capsule measured 9·0–10·8 × 2·8–3·2 μm and the smaller one measured 7·2–8·8 × 2·8–3·2 (figure 5). The polar filament in the larger polar capsule was thin with 8 coils wound in an anticlock wise direction and when fully everted measured 35–42 μm in length. The polar filament from the smaller polar capsule was significantly thick, deeply stained and appeared almost solid and had 5–6 coils wound in a clock-wise direction in the polar capsule. When fully everted the polar filament measured 20–28 μm in length. The sporoplasm was triangular in shape with rounded corners and the base was directed anteriorly (figure 7). Two deeply stained nuclei were placed a little apart along the longitudinal axis. The endosome was deeply stained but the nuclear membrane was not clear (figure 8). Some of the developing sporoblasts showed 6 nuclei, 2 lying below the capsule and 2 near the valves (between the polar capsule and the spore wall) which showed fine deeply stained chromatin granules dispersed over a wide area. A distinct nuclear membrane was not observed. The other 2 nuclei were located in the sporoplasm and have a distinct endosome and a delicate nuclear membrane.



Figures 1–9. *Myxosoma channai* n.sp. **1.** A cyst attached to the fin. **2.** T.S. kidney showing early cyst. **3.** A fresh spore. **4.** Sutural view of the spore. **5.** A spore stained with Giemsa. **6.** Spore showing extruded polar filaments : Note polar filaments of unequal thickness and length. **7.** Spores stained with iron haematoxylin. Note binucleate sporoplasm. **8.** Spore stained with Feulgen. **9.** A developing sporoblast.

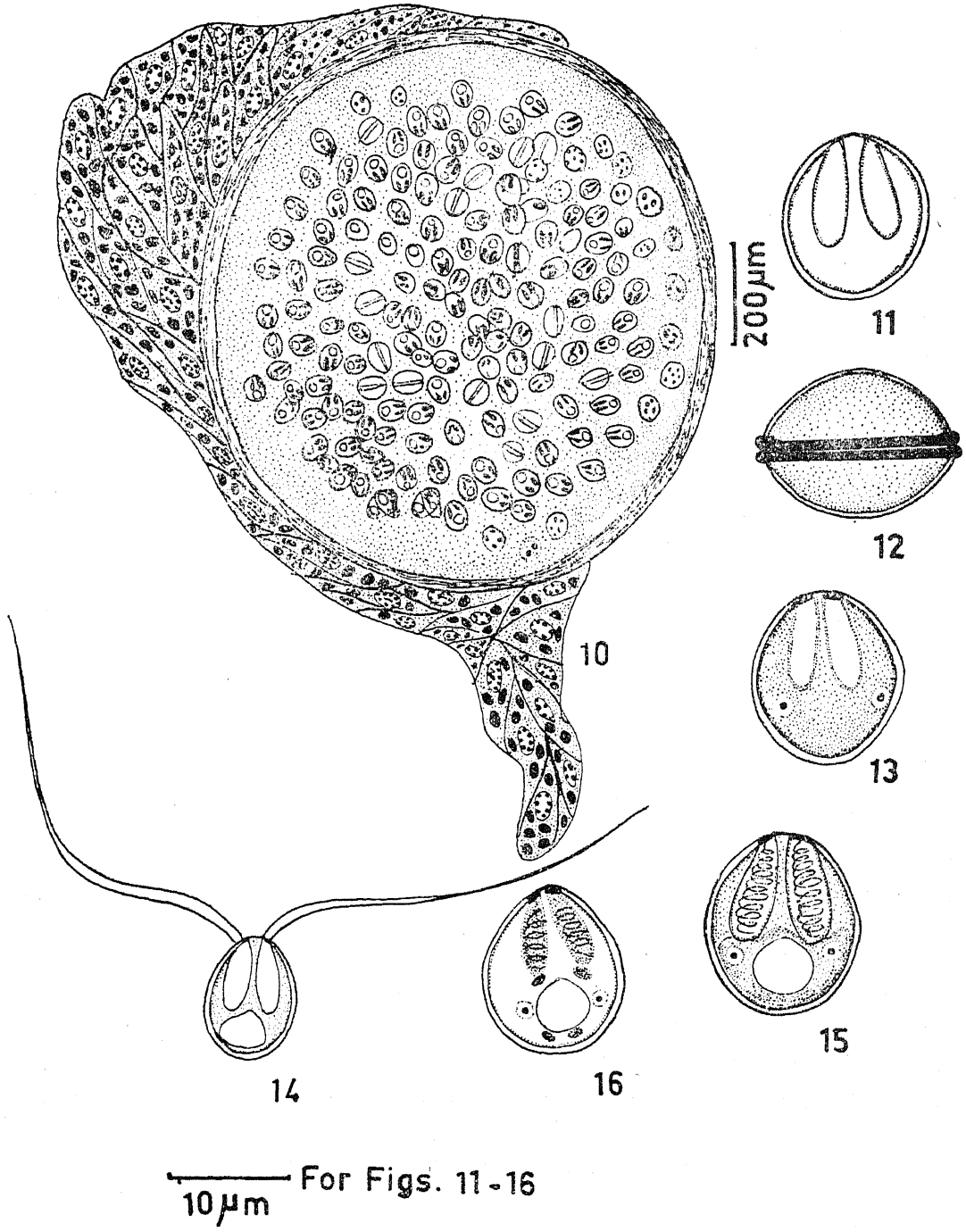
4. Discussion

16 species of myxosporidians belonging to 5 genera, *Myxobolus, Unicauda, Henneguya, Zschokella* and *Myxosoma* are reported from 3 species of *Channa* (=*Ophicephalus*), *C. punctata, C. striata* and *C. gachua* from different parts of India (table 2).

Many species of *Myxosoma* have been reported from a variety of marine and fresh water fishes from all over the world and 6 of them are from India, 3 of them from fresh water fishes of Hyderabad (Lalitakumari 1969) and 3 are from estuarine fishes of Waltair (Narasimhamurti 1970; Narasimhamurti and Kalavati 1979). Lalitakumari (1969) reported 3 species of *Myxosoma, M. indiae*, (12·4–15·0 × 6·4–8·6 μm), *M. hyderabadense* (9·3–11·5 × 5·0–8·0 μm) and *M. andhrae* (12·1–15·7 × 5·7–8·6 μm). Narasimhamurti (1970) and Narasimhamurti and Kalavati (1979) reported 3 more species, *M. intestinalis* (12·5–13·5 × 8·6–9·5 μm), *M. lairdi* (9·0–9·5 × 4·6–5·3 μm) and *M. microspora* (4·8–5·2 μm in diameter). Among them the spores of *M. hyderabadense, M. lairdi* and *M. microspora* are much smaller than the present form (14·5–18·0 × 6·0–6·5 μm) though the polar capsules were of a similar size. The spores of *M. indiae, M. andhrae* and *M. intestinalis* are bigger in size but are still smaller than the present form. The present form resembles *M. indiae* and *M. andhrae* in having unequal sized polar capsules. In *M. indiae* the unequal polar capsules were stated to be 2 or 3 in number and are smaller than those in the present form. The sporoplasm in *M. indiae* extends a little into the intercapsular space and hence differs from the present form. The spores of *M. andhrae* (which has the same host as the present form) though large are smaller than the present form and posses parietal folds which are absent in the present form. The present form resembles *M. andhrae* in having unequal-sized polar capsules but differs from it because the sporoplasm extends into the intercapsular space upto the anterior pole while in the present case it is triangular and is located at the posterior pole. Some of the spores in *M. andhrae* show an appendage measuring 1·0–3·6 μm which is absent in the present form. The polar filaments in *M. andhrae* appear to be similar (as seen from figure 20) while they appear and measure differently in the present form. The cysts in *M. andhrae* were attached to the gut by means of small fibres while in the present case the cysts are attached to fins or tissues directly or embedded in the tissue. Thus the only species of *Myxosoma, M. andhrae* which is reported from the same host as the present form differs considerably, hence this is considered a new species and the name *Myxosoma channai* n. sp. after the host is proposed for the same.

Myxobolus tripathii n. sp. Host : *Clarius* sp.
Site of infection : Wall of gut and visceral organs.
Type slides : Author's collection and Department of Zoology, Andhra University, Waltair (Andhra Pradesh).

3 out of 75 *Clarius* sp. ranging in size from 7·5–8·0 inches and collected from a tank near Visakhapatnam Port were found infected with a new species of *Myxobolus*. Opaque white cysts ranging in diameter from 0·5–1·0 mm were either superficially attached to the gut epithelium or deeply embedded in the liver tissue. The cyst wall was thin and single. Cellular hypertrophy associated with vacuo-



Figures 10–16. *Myxobolus tripathii* n.sp. **10.** T.S. liver showing an attached cyst. **11.** A fresh spore. **12.** Sutural view of the spore. **13.** A spore treated according to Feulgen's technique. **14.** Spore showing extruded polar filaments. **15.** Spore stained with Giemsa : Note coiled polar filament. **16.** A developing sporoblast.

lation of the cytoplasm was observed in the adjacent tissue cells. In some of the cells the nucleus also showed hypertrophy but there was no rupture of the cell (figure 10).

Fresh spores were either rounded or oval measuring 9·8–10·2 × 12·0–13·5 μm (figure 11). The spore walls were symmetrical and meet along the thickened sutural ridge which was further thickened at the poles (figure 12). 2 oval polar capsules of equal size measuring 5·0–6·0 × 2·5 μm were present, one on either side of the median line and they open independently to the outside. A prominent cushion-like thickening which was strongly basophilic was present at the openings (figure 13). The polar filaments showed 8 coils in each of the polar capsules and they were coiled in an anticlock wise direction. The polar filaments were uniformly thin and when fully everted measured 45–50 μm in length (figure 14). An oval iodinophilous vacuole measuring 3·6–4·5 μm which was stained with Lugol's iodine, positive to PAS and Best's carmine and negative to PAS after saliva digestion was present at the posterior pole (Figures 15 and 16). Similar tests conducted on the spores of the new species of *Myxosoma* reported earlier in this paper were negative. The sporoplasm was binucleate and extended like a rim round the iodine vacuole. 2 widely separated vesicular nuclei were present in the sporoplasm (figure 15). In immature spores 2 capsulogenous nuclei at the base of the polar capsules and 2 valvulogenous nuclei at the posterior end below the iodine vacuole were usually present in addition to the 2 sporoplasmic nuclei situated on either side of the iodinophilous vacuole (figure 16).

4. Discussion

The present form is placed in the genus *Myxobolus* because of the presence of an iodinophilous vacuole in the spore (Kudo 1920). Walliker (1968) synonymised the genus *Myxosoma* and *Myxobolus* because of the variability of occurrence of iodine vacuole. Lom (1969) endorsed the view of Walliker, thus abolishing the family Myxosomatidae. However, Galinsky and Meglitsch (1969) felt that the vacuole is useful and a well established taxonomic character. Podlipaivi (1974) stated that the iodine vacuole is " a real morphological formation in the spores of Myxobolidae and should be used in systematics". Moser and Noble (1977), Wold and Iverson (1978) expressed a similar opinion in the matter. Since a distinct iodine vacuole is present in the present form and accepting the opinion expressed by the above authors that the iodine vacuole has taxonomic importance, we propose to assign the parasite described here to the genus *Myxobolus* Buetschli 1882.

To date as many as 133 species of *Myxobolus* have been reported from a variety of marine and fresh water fishes from different parts of the world. Among them 19 species are described from the fresh water fishes of India. A perusal of table 2 shows that the only previous record of *Myxobolus* from *Clarius* is *M. clarii* (Chakravarty 1943) from the gall bladder, liver, testes, ovary and fat bodies. The cysts of the present form are bigger in size when compared to the cysts of *M. clarii*. The spores in *M. clarii* measured 11·3–12·4 × 10·3 μm, were subspherical in shape with a distinct straight sutural ridge whereas in the form described here the spores are spherical or ovoidal and have a thick sutural ridge which is further

Table 2. Checklist of myxosporidian parasites reported from the fresh water fishes of India.

Parasite	Host	Site of infection	Spore measurements (microns)
	Ord. : Unipolarina Fam : Ceratomyxidae Genus : *Ceratomyxa* Thelohan 1892		
1. *C. hilsae* Chakravarty 1939	*Hilsa ilisha*	Gall bladder	25–40
2. *C. gobiodesi* Chakravarty 1939	*Odontamblyopus rubicunda* ; *Colisa fasciatus*	Gall bladder	14–15
3. *C. scatophagi* Chakravarty 1943	*Scatophagus argus*	Gall bladder	16–26 (breadth)
4. *C. sagarica* Choudhury and and Nandi 1973	*Boleophthalmus boddaerti*	Bile	31 (breadth)
	Genus : *Leptotheca* Thelohan 1895		
5. *L. latesi* Chakravarty 1943	*Lates calcarifer*	Gall bladder	10·3–12·4 (diameter)
6. *L. macronesi* Chakravarty 1943	*Macrones gulio*	Gall bladder	10–14·4
7. *L. asymmetrica* Lalitakumari 1969	*Osteochilus neilli*	Gills, Gall bladder and intestine	9·4 (breadth)
	Genus *Sphaerospora* Thelohan 1892		
8. *S. sp.* *Southwell and Prashad 1918	*Barilins barna*	Under scales	No details
	Genus : *Gyrospora* Qadri 1962		
9. *G. crucifila* Qadri 1962	*Labeo fimbriatus*	Gills	9–10 × 8–8·5
	Fam : Chloromyxidae Thelohan 1892 Genus : *Chloromyxum* Mingazzini 1890		

10.	*C. amphipnoui* Ray 1933	*Amphipnous cruchia* *Heteropneustes fossilis* *Amblypharyngodon mola*	Gall bladder	8·24 × 10·3
11.	*C. mrigale* Tripathi 1952	*Cirrhina mrigala, C. reba*	Gall bladder	9–10 (diameter)
12.	*C. sp.* Tripathi 1952	*Xenentodon cancila*	Gall bladder	7·2 (diameter)
13.	*C. hoarei* Lalitakumari 1969	*Labeo nigripinnis*	Gall bladder	5·7–7·1 × 2·5–3·5
		Genus : *Kudoa* Meglitsch 1947		
14.	*K. chilakensis* Tripathi 1952	*Strongylura strongylura*	Muscles and peritoneum in oesophageal region	5·5–5·8 × 7·2
15.	*K. tetraspora* Narasimhamurti and Kalavati 1979	*Mugil cephalus*	Optic lobes	9 (diameter)
16.	*K. sphyraeni* Narasimhamurti and Kalavati 1979	*Sphyraena jello*	Gut	9·4 × 9·8
		Fam : Myxosomatidae Genus : *Myxosoma* Thelohan 1892		
17.	*M. indiae* Lalitakumari 1969	*Barbus sarana*	Gill filaments	12·4–15 × 6·4–8·6
18.	*M. hyderabadense* Lalithakumari 1969	*Barbus pinnarautus*	Gills	9·3–11·5 × 5–8
19.	*M. andhrae* Lalitakumari 1969	*Ophicephalus punctatus*	Outer wall of intestine	12·1–15·7 × 5·7–8·6
20.	*M. intestinalis* Narasimhamurti and Kalavati 1970	*Mugil waigensis*	Gut epithelium	12·5–13·5 × 8·6–9·5
21.	*M. lairdi* Narasimhamurti and Kalavati 1979	*Liza macrolepis*	Gut epithelium	4·6–5·2 × 9–9·5
22.	*M. microspora* Narasimhamurti and Kalavati 1979	*Mugil cephalus*	Gills	4·8–5·2 (diameter)
23.	*M. channai* n. sp. (present record)	*Channa punctata*	Fins, body muscles, liver and kidney	14·5–18 × 6–6·5

* From Kudo (1920).

Table 2. (*Contd.*)

1	2	3	4
	Family : Myxobolidae Genus : *Myxobolus* Buetschlii 1882		
24. *M. mrigale* Chakravarty 1939	*Cirrhina mrigala*	Scales	7·21–8·24 × 6·18
25. *M. calbausi* Chakravarty 1939	*Labeo calbasu, L. rohita, Cirrhina mrigala*	Gall bladder	12·4–15 × 8·2–10
26. *M. clarii* Chakravarty 1943	*Clarius batrachus*	Gall bladder, Liver, Testes fat bodies	11·3–12·4 × 10·3
27. *M. catlae* Chakravarty 1943	*Catla catla, Labeo rohita, Cirrhina mrigala*	Branchiae	14·5–16·5 × 6·18
28. *M. bengalensis* Chakravarty and Basu 1948	*Catla catla*	Branchiae	8·56–9·36 × 6·42–6·80
29. *M. indicum* Tripathi 1952	*Cirrhina mrigala*	Scales	7·21–8·24 × 6·18
30. *M. branchialis* Tripathi 1952	*Barbus sarana*	Gill filaments	6·4–7 × 4·5–5 × 3·2–4
31. *M. barbi* Tripathi 1952	*Barbus ticto*	Skin	12·6–13·5 × 9 × 5·5–6·3
32. *M. sphericum* Tripathi 1952	*Cirrhina mrigala*	Scales	9–9·5 × 7·2 × 5–5·5
33. *M. ophicephali* Bhatt and Siddiqui 1964	*Ophicephalus punctatus*	Accessory respirarory membrane	11·6–13·3 × 4·6–6·3
34. *M. aligarhensis* Bhatt and Siddiqui 1964	*Ophicephalus punctatus*	Accessory respiratory membrane	11·4–15 × 6–7·2
35. *M. pinnarauti* Lalitakumari 1969	*Barbus pinnarautus*	Gill filaments	9·7 × 7
36. *M. psilorhynchi* Lalitakumari 1969	*Psilorhynchus balitora*	Gill filaments	9·3–10·7 × 8·6–10
37. *M. ampullaceus* Lalitakumari 1969	*Barbus kolus*	Dorsal and ventral fins	8·6–10·7 × 6·4–7·9
38. *M. osmaniae* Lalitakumari 1969	*Barbus punaubensis*	Liver and intestine	12–15 × 7·1–10
39. *M. potaili* Lalitakumari 1969	*Labeo potail*	Gill contents	6·3–7·9 × 4·3–6·4

40.	*M. punctatus* Chaudhuri and Chakravarty 1970	*Ophicephalus punctatus*	Spleen (in all) Pharyngeal epithelium (in one)	12·29–15 × 5·72–7·86
41.	*M. tripathii* (present record)	*Clarius* sp.	Liver, intestine, muscles	9·8–12 × 10·2–13·5
		Genus *Unicauda* Davis 1944		
*42.	*U. ophicephali* Tripathi 1952	*Ophicephalus punctatus* ; *O. gachua*	Gills	19·8–26·4 × 5·4–7·2 × 2–3
*43.	*U. basirii* Bhatt and Siddiqui 1964	*Ophicephalus punctatus*	Mouth cavity Pharyngeal epithelium	25·6–39·2 × 3·2–4·4
*44.	*U. bicornuata* Chaudhuri and Chakravarty 1970	*Ophicephalus punctatus*	Branchial epithelium	35·73–45·73 × 14·29–27·15
*45.	*U. bengalensis* Chaudhuri and Chakravarty 1970	*Ophicephalus punctatus*	Roof of Buccal cavity	26·4–29·15 × 11·55–13·75
		Genus : *Henneguya* Thelohan 1892		
46.	*H. latesi* Chakravarty 1939	*Lates calcarifer*	Gills	26·2–36·2 × 6·3–8·2
47.	*H. ophicephali* Chakravarty 1939	*Ophicephalus punctatus*	Branchiae and muscles	41·5–52·6 × 6·18–7·21
48.	*H. otolithi* Ganapati 1941	*Otolithus ruber*, *O. maculatus*	Wall of Bulbous arteriosus	45–52 × 6–8·5
49.	*H. zahoori* Bhatt and Siddiqui 1964	*Ophicephalus punctatus*	Tissues of gill filaments	23·6 × 2·6
50.	*H. notopteriae* Qadri 1965	*Notopterus notopterus*	Gills	52–55 × 4·5–5
51.	*H. qadrii* Lalitakumari 1965	*Ophicephalus gachua*	Viscera	20·81 × 4·92
52.	*H. singhi* Lalitakumari 1969	*Notopterus osmaniae*	Gill contents	11·1–13·6 × 3·9–5·7 (Excl. caudal appendage)
53.	*H. jubilii* Qadri 1969	*Notopterus notopterus*	—	No measurements
54.	*H. waltairensis* Narasimhamurti and Kalavati 1975	*Ophicephalus punctatus*	Gill filaments	14·6–16·5 × 3·2–4 (Excl. caudal appendage)
54.	*H. ganapatiae* Qadri 1970	Notopterus notopterus	Gills	—

Table 2. (*Contd.*)

1	2	3	4
	Genus : *Thelohanellus* Kudo 1933		
55. *T. rohitae* Southwell and Prashad 1918	*Labeo rohita*	Gills	30–32 × 7–8
56. *T. seni* Southwell and Prashad 1918	*Catla catla Labeo rohita*	Branchiae	13·2–13·6 × 10·1–10·3
57. *T. catlae* Chakravarty and Basu 1948	*Catla catla*	Gills	19·26–21·40 × 10·7–12·4
58. *T. calbasui* Tripathi 1952	*Labeo calbasu*	Scales	9–10·8 × 7·2–5·5
59. *T. gangeticus* Tripathi 1952	*Labeo rohita, Chela bacaila*	Pectoral region	16·2–17·5 × 5·4–3·5
60. *T. mrigalae* Tripathi 1952	*Cirrhina mrigala*	Cysts on head between eyes	10·8–12 × 6·3–7·2 × 4·5–5·4
61. *T. andhrae* Qadri 1962	*Labeo fimbriatus*	Gills	11·25–14·5 × 4·5–5·5
62. *T. boggoti* Qadri 1962	*Labeo boggot*	Gills	11–12 × 6–7·5
63. *T. batae* Lalitakumari 1969	*Labeo bata*	Gills	11·4–13·6 × 4·3–7·9
64. *T. chelae* Lalitakumari 1969	*Chela becaila*	Bile	9·4–10·3 × 4·6–6
65. *L. potaili* Lalitakumari 1969	*Labeo potail*	Gill contents	12·1–16 × 7·9–9·5
66. *T. shortii* Qadri 1969	*Labeo fibimbriatus*	Fins	11·42–12·85 (12·53) × 6·42–7·14 (6·91)
	Genus : *Phlogospora* Qadri 1962		
67. *P. mysti* Qadri 1962	*Mystus bleekeri*	Gill contents	14–18 × 3·5–5
	Genus : *Myxobiatus* Davis 1944		
68. *M. mastacembeli* Qadri and Lalitakumari 1965	*Mastacembelus armatus*	Gills, intestine	23·5–30·5 × 4·6–6·16

		Genus : *Neohenneguya* Tripathi 1952		
69.	*N. tetraradiata* Tripathi 1952	*Odontamblyopus rubicundus*	Gills	79·20–93·6 × 5·4
		Order : Bipolarina Family : Myxidiidae Genus : *Myxidium* Butschlii 1882		
70.	*M. lieberkuhni* Buetschlii 1881	*Anabas testudineus*, *Boleophthalmus boddaerti*	Gall bladder	14·1 × 3·6
71.	*M. glossogobii* Chakravarty 1939	*Glossogobius giuris*	Gall bladder	12–15 × 8·5–10
72.	*M. heteropneustii* Chakravarty 1943	*Heteropneustes fossilis*	Gall bladder	14·42 × 6·18
73.	*M. procerum* var. calcarifory Chakravarty 1943	*Lates calcarifer*	Gall bladder	23–27 × 6·18
74.	*M. aori* Lalitakumari 1969	*Macrones aor*	Gall bladder	11·4–13·6 × 5·4–7·1
75.	*M. boddaerti* Choudhury and Nandi 1973	*Boleophthalmus boddaerti*	Gut	15·48 × 7·7
		Genus : *Zschokkella* Auerbach 1970		
76.	*Z. ilishae* Chakravarty 1943	*Hilsa ilisha*	Gall bladder	12·36 × 6·18
77.	*Z. fossilae* Chakravarty 1943	*Heteropneustes fossilis*	Gall bladder	10·3 × 4·12 × 5·18
78.	*Z. ophicephali* Lalitakumari 1969	*Ophicephalus striatus*	Gall bladder	12·9–14·3 × 5–7·1
79.	*Z. labeonis* Lalitakumari 1969	*Labeonigripinnis*	Gall bladder	9·3–12·9 × 4·3–7·1
		Genus : *Sphaerospora* Thelohan 1892		
80.	*S. puttai* Tripathi 1952	*Odontamblyopus rubicundus*	Gall bladder	28·8–30 × 5–5·5
81.	*S. theraponi* Tripathi 1952	*Therapon jarbua*	Gall bladder	19·8 × 5·4

Table 3. Myxosporidia reported from *Channa* (*Ophicephalus*).

	Parasite	Host	Site of infection	Description of the (spore Measurements in microns)
1.	*Myxosoma andhrae* Lalitakumari 1969	*Ophicephalus punctatus*	Outer wall of intestine	Spores pyriform ellipsoidal, in some, the posterior end is drawn into an appendage 1·4–3·6 in length. Spores 12·1–15·7 × 5·7–8·6. Polar capsules unequal. Polar filament length not given.
2.	*M. channai* n. sp. (present record)	*Channa punctata* (=*Ophicephalus punctatus*)	Kidney, Liver, body muscles and fins	Spores pyriform or oval 14·5–18·0 × 6·0–6·5. Thick median sutural ridge. Polar capsules dissimilar. Large polar filament 35·0–42·0, small 20·0–28·0. No iodinophilous vacuole.
3.	*Myxobolus ophicephali* Bhatt and Siddiqui 1964	*Ophicephalus punctata*	Accessory respiratory organs	Spores pyriform. 11·6–13·3 × 4·6–6·3. Polar capsules unequal. Large 6·9–8·5 × 1·2–2 ; Small 6·7–7·3 × 1·2–2.
4.	*M. aligarhensis* Bhatt and Siddiqui 1964	*Channa punctata* (= *Ophicephalus punctatus*)	Accessory respiratory organs	Spores pyriform, shell valves smooth and symmetrical 11·4–15 × 6–7·92. Polar capsule equal 7·6–9·2 × 1·2–2·2 polar filament not mentioned.
5.	*M. punctatus* Chaudhuri and Chakravarty 1970	*Channa punctata* (= *Ophicephalus punctatus*)	Spleen and pharyngeal epithelium	Spores pyriform 12·29–15 × 5·72–7·86. Pola capsules equal 8·57–10 × 2·14–2·86 Polar firlament 42·25–32·56.

*6.	*Unicauda ophicephali* Tripathi 1952	*Ophicephalus punctatus* and *O. gachua*	Gills	Spores pyriform 19·8–26·4 × 5·4–7·2. Caudal prolongation 20·5–23·8 polar capsules unequal large : 7·2–8·1 × 2–3 small : 5·5–7·2 × 2–3. Polar filament not recorded.
*7.	*U. basirii* Tripathi 1952	*Ophicephalus punctatus*	Mouth cavity Pharyngeal epithelium	Spores oval the posterior end of shell. valve prolonged into a more or less extended process to form a single caudal appendage. Spore 25·6–39·2 × 3·2–4·4. Caudal appendage 10–20·3.
*8.	*U. bicornuata* Chaudhuri and Chakravarty 1970	*Ophicephalus punctatus*	Branchial epithelium and Gills	Spore oblongate. Posterior portion gradually tapering and continued into long caudal prolongation. Characteristically forked at the posterior end. 35·73–45·3 × 2·86–4·29. Caudal prolongation 14·29–27·15.
*9.	*Unicauda bengalensis* Chaudhuri and Chakravarty 1970	*Ophicephalus punctatus*	Roof of buccal cavity	Spores oblongate, spore body continued into a long caudal prolongation which is single and undivided. Spore 26·4–29·15 × 2·75–3·85. Caudal prolongation 11·55–13·75. Polar capsules equal, 3·33–3·56 × 1·1–1·38. Polar filament 18–27.
10.	*Henneguya ophicephali* Chakravarty 1939	*Ophicephalus punctatus*	Branchiae and muscles	Spore ovoid or oblongate tail bifurcated 41·5–52·5 × 6·18–7·21. Caudal prolongation 20–32. Polar capsule 6·18–9·27 × 2·06–3. Polar filament 26–32.
11.	*H. qadrii* Lalitakumari 1965	*O. gachua*	Viscera near spleen	Spores oval, caudal appendage bifurcated spore 15·4–26·9 × 4·62–5·39. Caudal appendage 6·16–14·63. Polar capsules unequal. Large : 4·62–6·16 × 1·15–1·92 small : 3·85–4·62 × 1·15–1·92. Polar filament large 41·85–53·13, small 28–46·2.

Table 3. (*Contd.*)

1	2	3	4	5
12.	*H. zahoori* Bhatt and Siddiqui 1964	*O. punctatus*	Tissue of gill filaments	Spore biconvex 20–30·6 × 2·1–3 caudal appendage bifurcated 12–18·6. Polar capsules equal 4·9–6·7 × 0·7–1·1.
13.	*H. jubili* Qadri 1969	*Notopterus notopterus*		Only a short description. No measurements given.
14.	*H. ganapatiae* Qadri 1970	*Notopterus notopterus*	Gill contents	Length of the spore 9·28–9·99 (9·72). Breadth of the spore 4·0–4·28 (4·50) Length of the caudal appendage 21–25 (22·25), Length of polar capsule 3·21–3·57 (3·32). Breadth of polar capsule 1·42–1·78 (1·64).
15.	*H. waltairensis* Narasimhamurti 1975	*Ophicephalus punctatus*	Gill filaments	Spore 14·6–16·5 × 3·2-4 Caudal prolongation 40–50. Polar capsules equal 10–12 × 1·6–2·5.
16.	*Zschokkella ophicephali* Lalitakumari 1969	*O. striatus*	Gall bladder	Spores gibbous shaped in front view 12·9–14·3 × 5–7·1. Polar capsule spherical with prominent neck. 3·6–3·9. Polar filament 61–78 sporoplasm trapezoid.

* Wyatt (1979) while discussing the characters of the genus *Unicauda* stated that " *Unicauda* was established by Davis for organisms with unbranched tails which are not extensions of the spore valves. In general the anterior end of the tail has a concavity and the spore sits in this cup". Hence he says *U. basirii* Bhatt and Siddiqui is an example of misuse of the definition of Davis—and all the 4 species described above do not fit into the genus. He, however, did not suggest a new place for the above species in any one of the described genera.

thickened at the poles. The 2 polar capsules in *M. clarii* are pear-shaped measuring 6·18 × 3·09 μm with the anterior end drawn out into a narrow tube and open to the outside at the same point (figures 60 and 65 of Chakravarty 1943). The sporoplasm occupies the entire extra capsular region and the 2 nuclei are closely associated (Figs. 63 and 64 of Chakravarty 1943) while in the present form the 2 oval polar capsules are smaller measuring 5·0–6·0 × 2·0–2·5 μm and open to the outside independently, one on either side of the median line and the openings are covered by a cushion-like thickening. Further the sporoplasmic nuclei are always present one on either side of the vacuole.

In view of the differences mentioned above, we consider the present form as a new species for which the name *Myxobolus tripathii* n. sp. is proposed.

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